WHAT IS CLAIMED IS:

1. Optical apparatus, comprising:

an amplifier fiber having a doped core surrounded by a cladding, said core doping providing optical gain for light propagating therein in a propagation direction when said doped core is energized by pump light absorbed therein; and

an optical arrangement for inserting pump-light from a source thereof into said cladding of said amplifier fiber such that said pump light propagates in said cladding thereof in said propagation direction; and

at least one recovery fiber for receiving an unabsorbed portion of said propagated pump light from said cladding and for re-inserting said unabsorbed portion of said pump-light into said cladding for re-propagation therein.

2. The apparatus of claim 1, wherein said amplifier fiber includes first and second fiber Bragg gratings therein forming a laser resonator.

3. The apparatus of claim 1, wherein said recovery fiber is in the form of a continuous loop and a portion thereof is twisted around said amplifier fiber.

4. The apparatus of claim 1, wherein said recovery fiber is arranged to couple pump light out of said amplifier cladding at a first location thereon and re-couple said pump light into said amplifier cladding at a second location thereon, said first location being downstream of said second location in said propagation direction.

5. The apparatus of claim 4, wherein said recovery fiber is fused together with said amplifier fiber cladding at said first and second locations.

6. The apparatus of claim 1, wherein said optical arrangement includes at least one pump fiber.

7. The apparatus of claim 5, including M pump fibers and N recovery fibers each of which having first and second ends, wherein said first ends of said pump and recovery fibers are formed into a first composite fiber which is coupled to an input end of said amplifying fiber, wherein said second ends of said pump and recovery fibers are formed into a second composite fiber coupled to an output end of said amplifying fiber, and wherein pump light is inserted from said source thereof into said cladding via said M pump fibers and is received from said amplifier cladding and reinserted into said amplifier cladding via said N recovery fibers.

8. The apparatus of claim 7, wherein said source of pump light includes M diode-laser emitters each thereof delivering light into a second end of a corresponding one of said M pump fibers.

9. The apparatus of claim 8, wherein M is 2 and N is 4.

10. The apparatus of claim 7, wherein said pump and recovery fibers are multimode fibers.

11. The apparatus of claim 7, wherein at least one of said first and second composite fibers includes a bundled region wherein the fibers thereof are bundled and fused together, the bundled region extending to a tapered region, said tapered region tapering to a minimum diameter about equal to the diameter of said amplifier fiber, the minimum diameter of said tapered region being coupled to said amplifying fiber.

12. The apparatus of claim 7, wherein at least one of said first and second composite fibers includes a bundled region wherein the fibers thereof are bundled and fused together, the bundled region extending to a tapered region, said tapered region tapering to a minimum diameter about equal to the diameter of said amplifier fiber, the minimum diameter of said tapered region being spliced to an intermediate multimode fiber region having about the same diameter as the diameter of said amplifier fiber, and said intermediate multimode fiber region being coupled to said amplifying fiber.

13. The apparatus of claim 6, including M pump fibers and N recovery fibers each of which have first and second ends, wherein said first ends of said pump and recovery fibers are grouped around and optically coupled to said amplifier fiber cladding at a first location on said amplifying fiber, wherein said second end of said pump and recovery fibers are grouped around and optically coupled to a second location on said amplifying fiber, said second location being downstream of said first location in said propagation direction, and wherein pump light is inserted from said source thereof into said cladding via at least one of said M pump fibers and is received from said amplifier cladding and reinserted into said amplifier cladding via one or more of said N recovery fibers.

14. The apparatus of claim 13, wherein said source of pump light includes M diode-laser emitters each thereof delivering light into a second end of a corresponding one of said M pump fibers.

15. Optical apparatus, comprising:

an amplifier fiber having a doped core surrounded by a cladding, said core doping providing optical gain for light propagating therein in a propagation direction when said doped core is energized by pump light absorbed in said core;

an optical arrangement including a plurality of N + M, transmission fibers each of said transmitting fibers having first and second ends;

said first ends of said N + M transmission fibers being formed into a first composite fiber having a diameter about equal to the diameter of said amplifying fiber, said first composite fiber being coupled to an input end of said amplifying fiber;

said second ends of said N transmission fibers being formed into a second composite fiber having a diameter about equal to the diameter of said amplifying fiber said second composite fiber being coupled to an output end of said amplifying fiber; and

wherein pump light is inserted from said source thereof into said cladding via at least one of said M fibers, and is received from said amplifier cladding and

re-inserted into said amplifier cladding via one of said N fibers, whereby pump light is caused to circulate in said amplifier cladding in said pump direction.

16. The apparatus of claim 15, wherein said amplifier fiber has first and second fiber Bragg gratings therein forming a laser resonator.

17. The apparatus of claim 15, wherein at least one of said first and second composite fibers includes a bundled region wherein said transmission fibers are bundled and fused together, the bundled region extending to a tapered region wherein said fused bundled region tapers to a minimum diameter about equal to the diameter of said amplifier fiber, the minimum diameter of said tapered region being coupled to said amplifying fiber.

18. The apparatus of claim 15, wherein at least one of said first and second composite fibers includes a bundled region wherein said transmission fibers are bundled and fused together, the bundled region extending to a tapered region wherein said fused bundled region tapers to a minimum diameter about equal to the diameter of the amplifier fiber, the minimum diameter of said tapered region being spliced to an intermediate multimode fiber region having about the same diameter as the diameter of said amplifier fiber, and said intermediate multimode fiber region being coupled to said amplifying fiber.

19. Optical apparatus, comprising:

an amplifier fiber having a doped core surrounded by a cladding, said core doping providing optical gain for light propagating therein in a propagation direction when said doped core is energized by pump light absorbed in said core;

an optical arrangement including a plurality of N + M transmission fibers each of said transmitting fibers having first and second ends;

said first ends of said N + M transmission fibers being grouped around and optically coupled to said amplifier fiber cladding at a first location on said amplifying fiber;

said second ends of N of said transmission fibers being grouped around and optically coupled to a second location on said amplifying fiber, said second location being downstream of said first location in said propagation direction; and

wherein pump light is inserted from said source thereof into said cladding via at least one of said M fibers and is received from said amplifier cladding and re-inserted into said amplifier cladding via one of said N fibers, whereby pump light is caused to circulate in said amplifier cladding in said pump direction.

20. A method of optically pumping an amplifier fiber the amplifier fiber having a doped core surrounding by cladding, the method comprising:

providing a source of pump light;

directing pump light from said source thereof into the amplifier cladding such that said pump light propagates in said cladding and a portion thereof is absorbed in the doped core;

coupling an unabsorbed portion of said optical pump light out of the amplifier cladding; and

re-coupling said out-coupled pump light into the amplifier cladding such that said out-coupled pump light is re-propagated through the amplifier cladding.

21. The method of claim 20, wherein said re-coupling is arranged such that said propagating and re-propagating occur in the same direction.

22. The method of claim 20, wherein said propagating and re-propagating occur in opposite directions.

23. Optical apparatus, comprising:

an amplifier fiber having a doped core surrounded by a cladding, said core doping providing optical gain for light propagating therein in a propagation direction when said doped core is energized by pump light absorbed therein;

a pump fiber, arranged to insert pump-light from a source thereof into said cladding of said amplifier fiber such that said pump light propagates through said cladding thereof in a first propagation direction; and

a recovery fiber arranged to receive an unabsorbed portion of said propagated pump light from said cladding, and to re-insert said unabsorbed portion of said pump-light into said cladding for re-propagation therein in a second propagation direction opposite to said first propagation direction.

24. The optical apparatus of claim 23, wherein said recovery fiber is terminated by a mirror, and said unabsorbed pump light, after reflection from said mirror is reinserted in said fiber cladding a location thereon at which it is received.

25. Optical amplification apparatus comprising:

a source of light to be amplified, the light having a first wavelength

a first optical fiber having a core surrounded by cladding and arranged to transmit light along said core to a second optical fiber, said second optical fiber being arranged to convert at least a portion of the first wavelength light to light having a second wavelength, different from the first wavelength;

an optical fiber isolator formed in said first optical fiber between said light source and said second optical fiber and arranged to direct second wavelength light out of said first optical fiber core;

said second optical fiber being connected to a wavelength selective fiber coupling device arranged to couple second wavelength light into a third optical fiber for transmission to an optical amplifier, while directing unconverted first wavelength light out of the apparatus; and

wherein one of said second wavelength light reflected from said optical amplifier and amplified spontaneous emission emitted by said optical amplifier having a wavelength about equal to said second wavelength, propagates back along said third optical fiber, is coupled by said wavelength selective coupler into said second optical fiber, propagates through said second optical fiber into said first

optical fiber core, and at least a portion thereof prevented by said fiber isolator from propagating further in said first optical fiber core.

26. The apparatus of claim 25, wherein said optical isolator is one of a blazed fiber Bragg grating, a slanted fiber Bragg grating, and a long period fiber Bragg grating.

27. The apparatus of claim 25, wherein said fiber isolator includes an optical fiber doped with ions that absorb light at said second wavelength and transmit light at said first wavelength.